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Conference Paper

Conference Report 1st European Hail Workshop

Olivia Martius[1*], Michael Kunz[3], Luca Nisi[1,2] and Alessandro Hering[2]

[1]Oeschger Centre for Climate Change Research, Mobiliar Lab for Natural Risks and Institute of Geography, University of Bern, Switzerland
[2]MeteoSwiss, Radar, Satellite and Nowcasting division, Locarno-Monti, Switzerland
[3]Institute for Meteorology and Climate Research (IMK), Karlsruhe Institute of Technology, Germany

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Abstract

The 1st European Hail workshop took place in Bern in June 2014. The workshop was organized into five topical session i) Convection and hail in a changing climate, ii) Microphysics and dynamics of hailstorms, iii) Hail damage and hail damage prevention, iv) Local probabilities and long-term statistics of hail, and v) Nowcasting and forecasting of hail. This report summarizes the scientific contributions presented and the open scientific questions discussed at the workshop.

Keywords: hail

Introduction

In recent years, hail damage has increased substantially in several European regions. Despite the high damage potential of large hail in the order of billions of Euros, knowledge on hail frequency, microphysical processes and temporal variability is still limited. To foster the scientific exchange on this topic, the Oeschger Centre for Climate Change Research (OCCR), the Karlsruhe Institute of Technology (KIT), the Mobiliar Lab, and MeteoSwiss jointly organized the 1st European Hail Workshop, which took place at the University of Bern from 25 to 27 June 2014. The overall aim of the workshop was to bring together scientists working on hail-related research questions as well as practitioners from the operational weather forecast community and from the insurance industry. The topical scope was intentionally very broad ranging from fundamental research topics to various application aspects. The workshop – attended by more than 130 participants from 18 different countries and from 21 different operational weather services – was structured into the following five thematic sessions:

- Convection and hail in a changing climate
- Microphysics and dynamics of hailstorms
- Hail damage and hail damage prevention
- Local probabilities and long-term statistics of hail
- Nowcasting and forecasting of hail

The detailed program of the workshop and PDFs of most of the presentations and posters, as well as a recording of the Nowcasting and Forecasting session are available from the following website:
http://www.oeschger.unibe.ch/events/conferences/hail/programme_en.html

*Corresponding author: Olivia Martius, Oeschger Centre for Climate Change Research, Mobiliar Lab for Natural Risks and Institute of Geography, University of Bern, Switzerland, Hallerstrasse 12, 3012 Bern, Switzerland, e-mail: Olivia.martius@giub.unibe.ch

Convection and hail in a changing climate

The workshop opened with contributions focusing on the important topic of convection and hail in a changing climate, which underlined the big research gap that is still present in this field of research. The scarce availability of reliable long-term information of hail frequency on the ground hampers the analysis of possible trends in recent decades. Further on, there is a stark mismatch of scales between the spatial resolution of state-of-the-art climate model projections and the scale of the processes that result in severe convection and hail.

One approach to tackle this problem is to identify the meso-scale to synoptic-scale environment(s) beneficial for hailstorm formation and to use these parameters as proxies for hail in reanalysis or climate model data. Corresponding analyses are performed based on local observations (e.g., sounding data) and gridded re-analysis and climate model data sets (presentations by Sanderson et al., Zhang and Li, Mohr and Kunz, Manzato, Pucik et al., Stoll and Jordi). This approach, however, currently does not include effects of changing aerosol concentrations or changes in the microphysical processes.

Microphysics and dynamics of hailstorms

Current challenges in modeling the microphysical processes involved in hail formation and melting include the diversity of ice nuclei (presentation by Hoose), the representation of internally mixed (partly frozen – partly liquid) hailstones and their properties (e.g., spongy ice) (presentations by List, Sant and Seifert), and the fall speed and terminal velocity of hail and graupel (presentation by Heymsfield and Wright). These challenges can be addressed through combined efforts in model development and high-quality in-situ and laboratory measurements. The further development of improved hail micro-

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physics schemes is also of central importance for numerical weather prediction (NWP) activities (presentations by Milbrandt and Martynov et al.).

Hail damage and hail damage prevention

A detailed understanding of the microphysical properties of hail is also the basis for hail suppression attempts. Several hail suppression programs, mainly run in agriculture intensive areas, using aircraft or ground-based systems for seeding with silver-iodide were presented at the workshop (presentations by Foris, Teschl et al., Berthet and Dessens). All programs include a combination of hailstorm nowcasting and monitoring activities, insurance solutions and hail suppression techniques. These programs provide some of the longest observations of hail occurrence and hailstone properties in Europe.

Insurance companies have reported on increasing trends in hail losses to properties and vehicles in recent decades. The current focus is on the development of sophisticated hail loss models (presentations by Geissbühler and Ritz, Griesser et al., Schmidberger et al., Victor et al.). Challenges faced when constructing the loss models include (i) a lack of direct observational data (e.g., on hailstone sizes and shapes), (ii) the complexity of the vulnerability of buildings and constructions to hail (e.g., residential, industrial and commercial buildings), and (iii) consideration of the time of the year (e.g., mature vs. premature crops) and of human actions (e.g., closing of window blinds) (presentations by Imhof and Choffet, Heidemann). Hail loss models apply statistical methods to increase the number of severe hail swaths beyond available observations (presentations by Schmidberger et al., Geissbühler and Ritz, Griesser et al.).

Local probabilities and long-term statistics of hail

The statistical approach used for hail loss models is complementary to a series of hail frequency climatologies that are currently being established in many countries, mainly based on single polarization radar observations covering the last 10 to 20 years (presentations by Nisi et al., Meyer et al., Kunz et al., Lukach and Delobbe, Rigo et al., Pocakal, Stolaki, Schemm et al.). Using such data sets requires ground observations (e.g., hail pads, insurance loss data) for calibration and verification. Additional observations are provided, for example, by the comprehensive archive of the European Severe Weather Database (ESWD, Dotzek et al., 2009, presentation by Groenemeijer et al.) that collects hail reports from voluntary observers and weather services. Also relying on voluntary hail reports is the crowdsourcing mPing smart phone citizen science project, currently established in the US (Elmore et al., 2014).

Nowcasting and forecasting of hail

The need for and importance of reliable ground observations have been underlined from the research community, the insurance industry, but also from the weather services. These observations are required for model calibration and verification of radar- and numerical weather prediction (NWP) model-based nowcasting tools, but also for developing and extending radar-based hail products including new dual-polarization products. Nowcasting methods combine radar information with NWP model output and statistical tools to provide partially fully-automated hail warnings on time-scales from minutes up to a few hours (presentations by Hering et al., Auer et al., Winterrath, Kaltenboeck and Ryzhkov). Nowcasting includes the tracking of hail cells and a prediction of their path. Besides radar data other sources of remote sensing information such as lightning- (poster by Rigo and Pineda, presentations by Betz and Moehrlein, Jurkovic and Mahovic, Schmid) and satellite-based estimates of effective radii have proven valuable for nowcasting purposes. Polarimetric radars, finally, offer the potential to provide further information on the hailstone size (e.g., Ryzhkov et al. 2013) and shape distribution and falling behavior, but this still needs some verification (presentation by Lakshmanan).

Summary

The workshop demonstrated the valuable collaboration between research and business in a field with scarce data availability. Research efforts in the next couple of years should be dedicated to increase the quantity and quality of hail observations. These efforts will be a combination of rescuing and processing available data and exploiting new data collection opportunities and new observing systems (e.g., automatic hail sensors, presentation by Löffler-Mang et al.). These data sets will be the foundation for improved nowcasting and forecasting systems of hail, for improved process understanding and the development of novel microphysical schemes for NWP and climate models, as well as for long-term hail frequency and trend studies.

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